ENSO in an Ensemble of Ocean Reanalyses

Ben Giese/Kelley Bradley TAMU

Gil Compo / Prashant Sardeshmukh / Jeff Whitaker NOAA/CIRES

OARCA – Ocean Atmosphere Reanalysis

- 20CRv2 - Forced with 1 member HadISST (1871-2012)
- SODAsi.2 – 18 Member Ocean reanalysis (1845-2012)
- 20CRv2c – Forced with 18 members of SODAsi.2 (1831-2012)
- SODAsi.3 – 8 Member ocean reanalysis forced with 20CRv2c (1831-

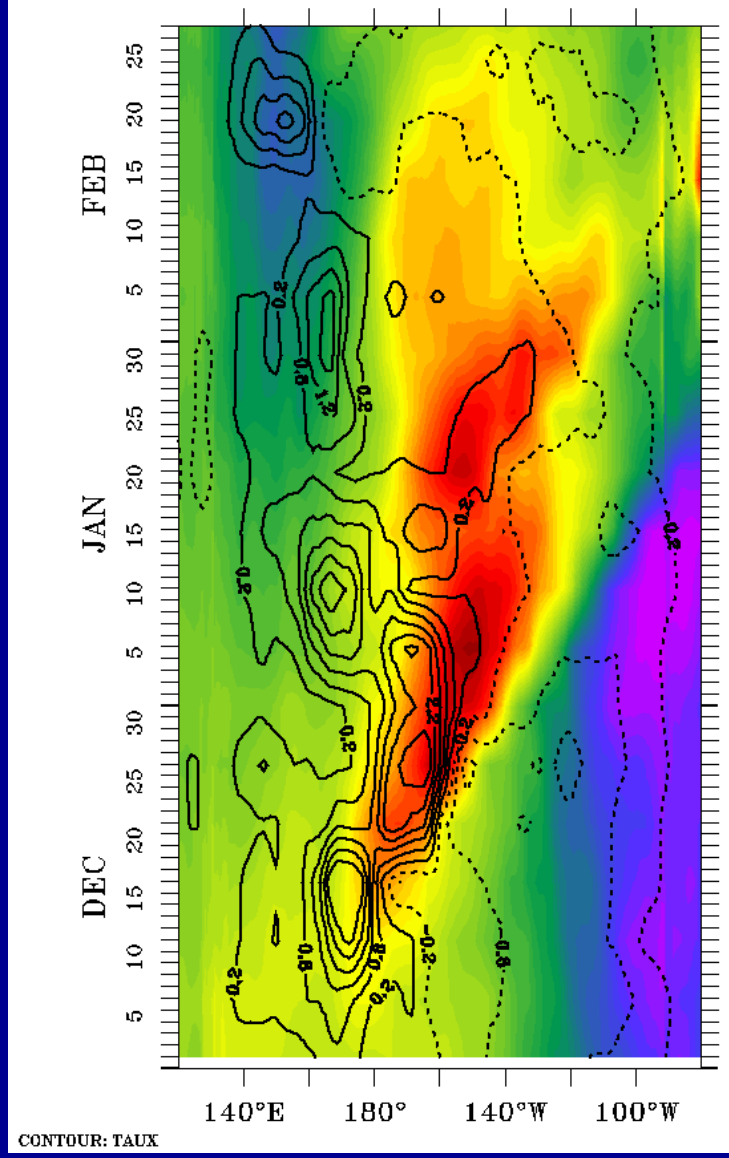
Shading: SSH Contours: Zonal wind stress

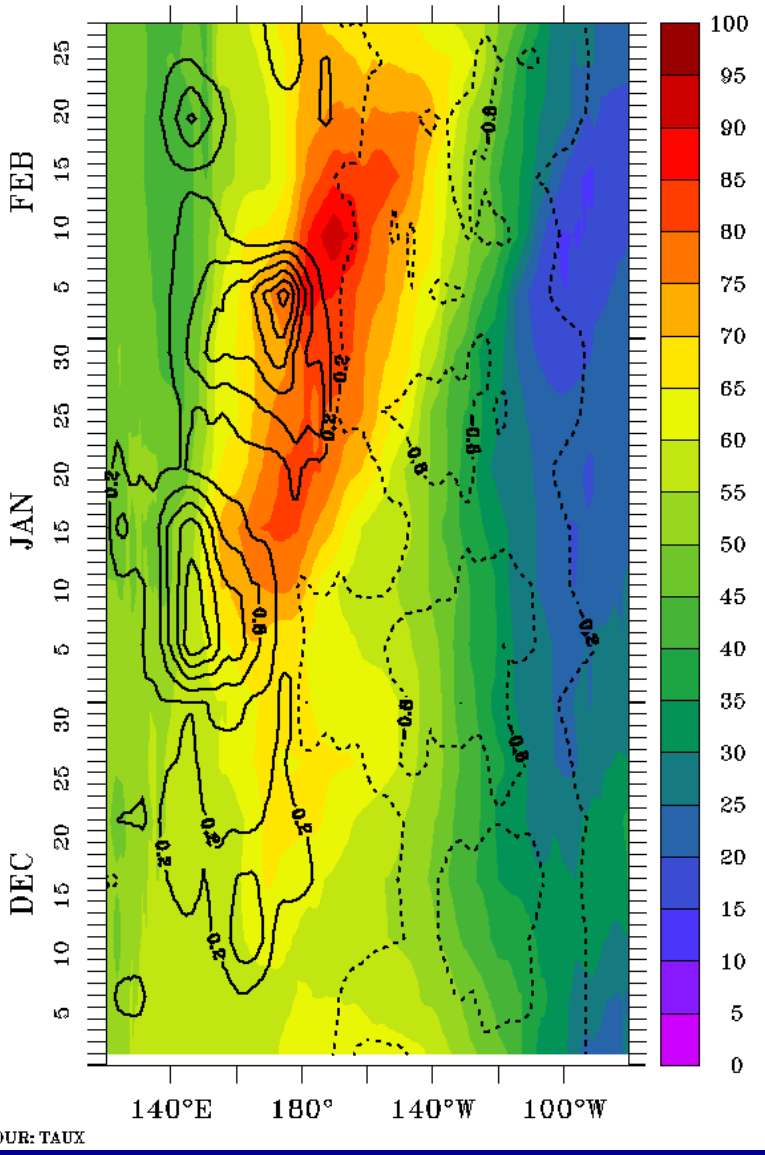
Strong ENSO

Weak ENSO

1918

1919



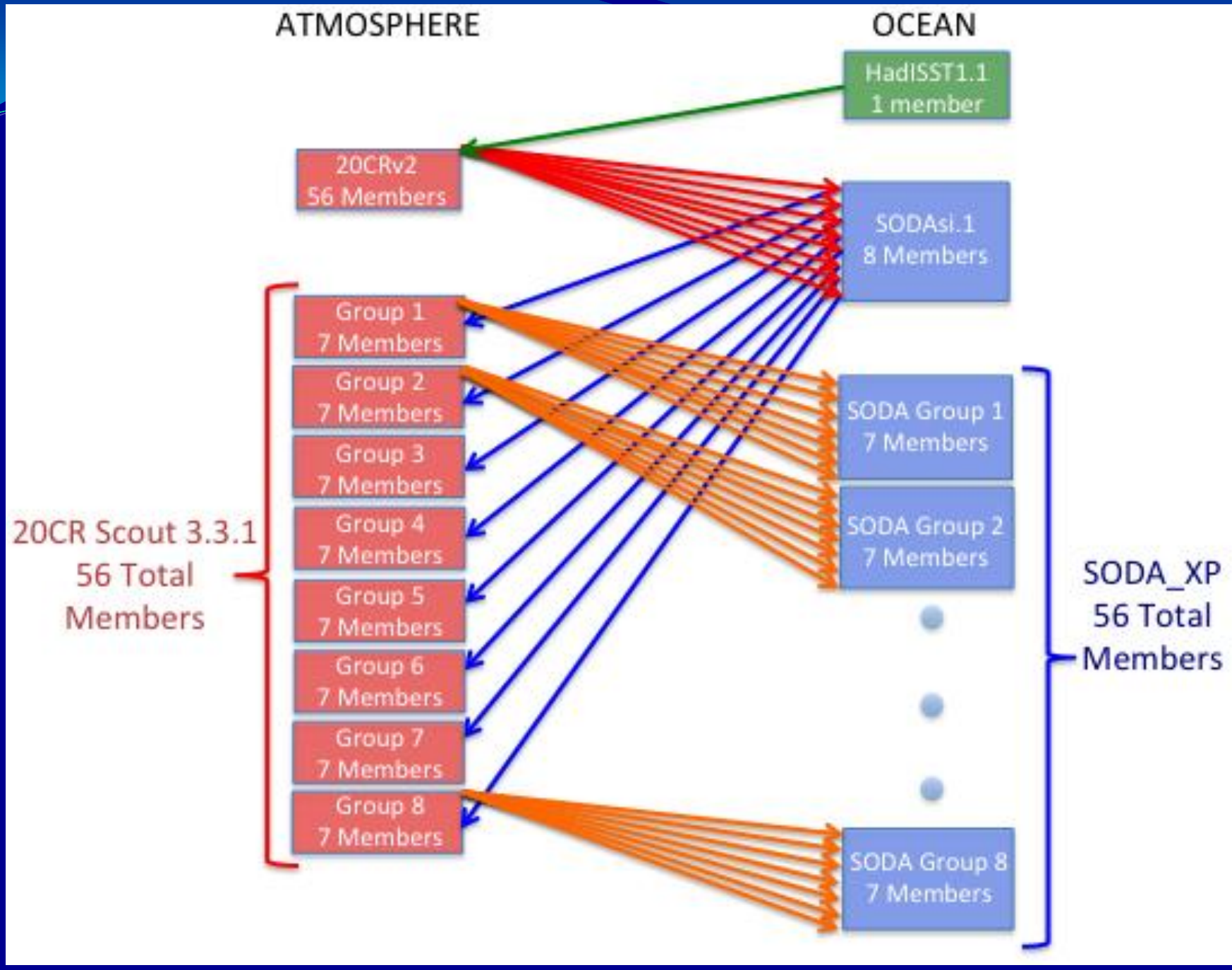


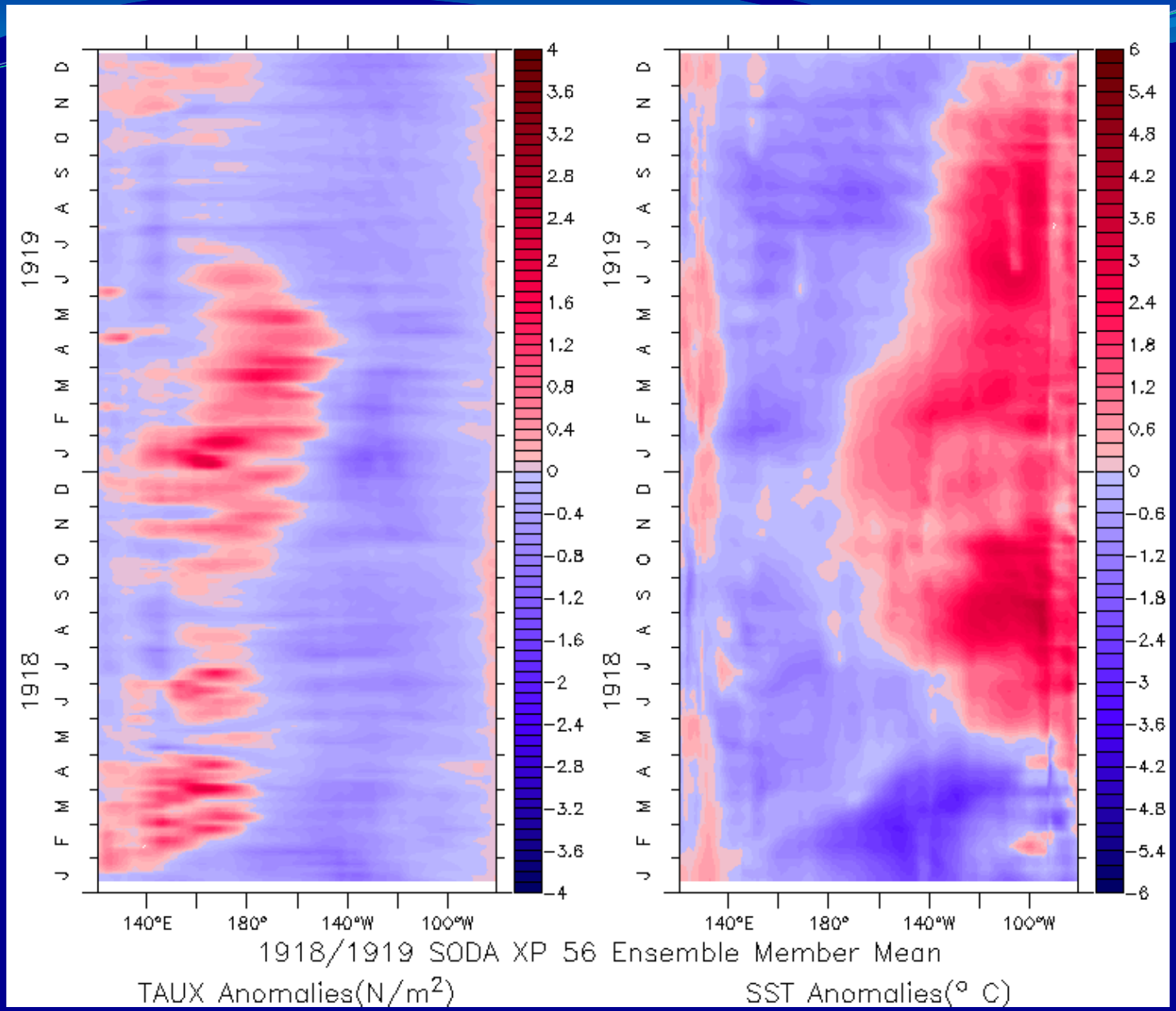
SODA XP – 56 Ensemble members

Five year global ocean assimilation & simulation runs

- Two periods, both with a strong El Niño
  - 1916-1920, sparse observations (WWI)
  - 1996-2000, densely observed

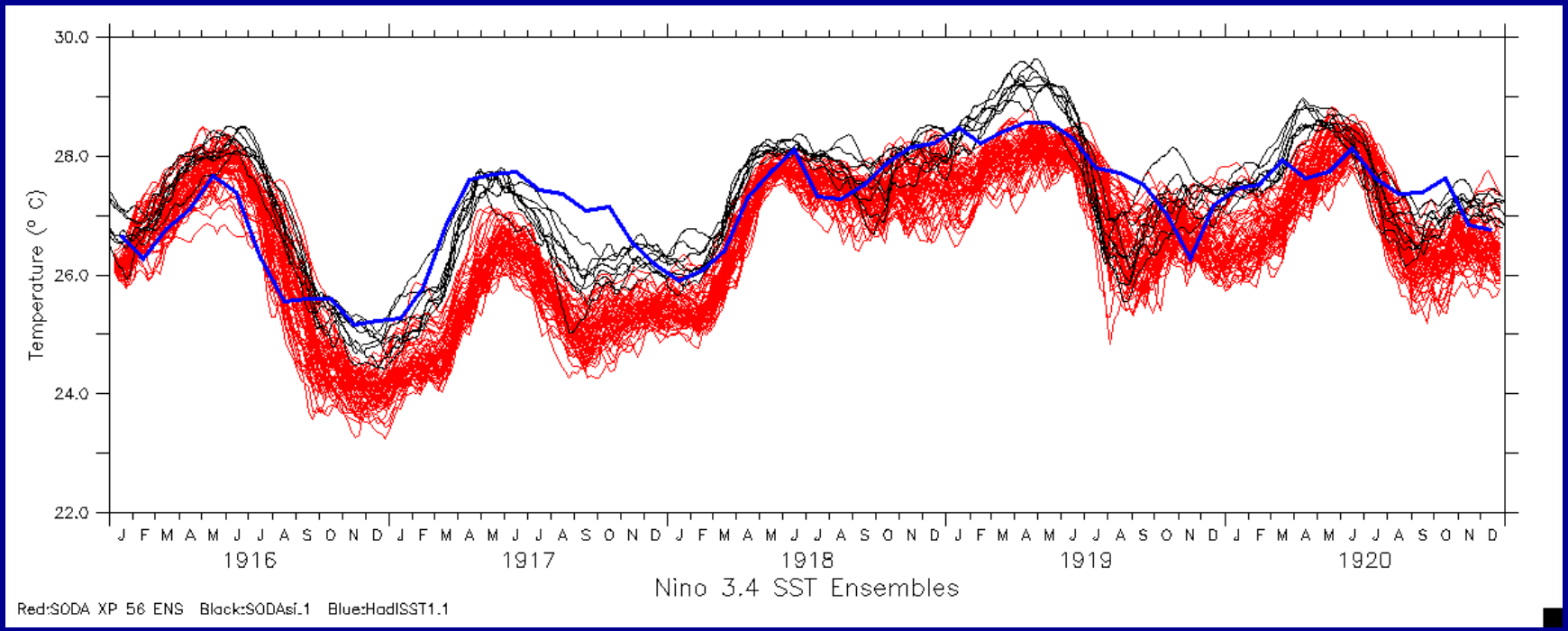
- Four runs with 56 ensemble members each


ATMOSPHERE
OCEAN
HadISST1.1
1 member
20CRv2
56 Members
SODAsi.1
8 Members
Group 1
7 Members
Group 2
7 Members
Group 3
7 Members
Group 4
7 Members
Group 5
7 Members
Group 6
7 Members
Group 7
7 Members
Group 8
7 Members
20CR Scout 3.3.1
56 Total
Members
SODA Group 1
7 Members
SODA Group 2
7 Members
SODA Group 8
7 Members
SODA_XP
56 Total
Members

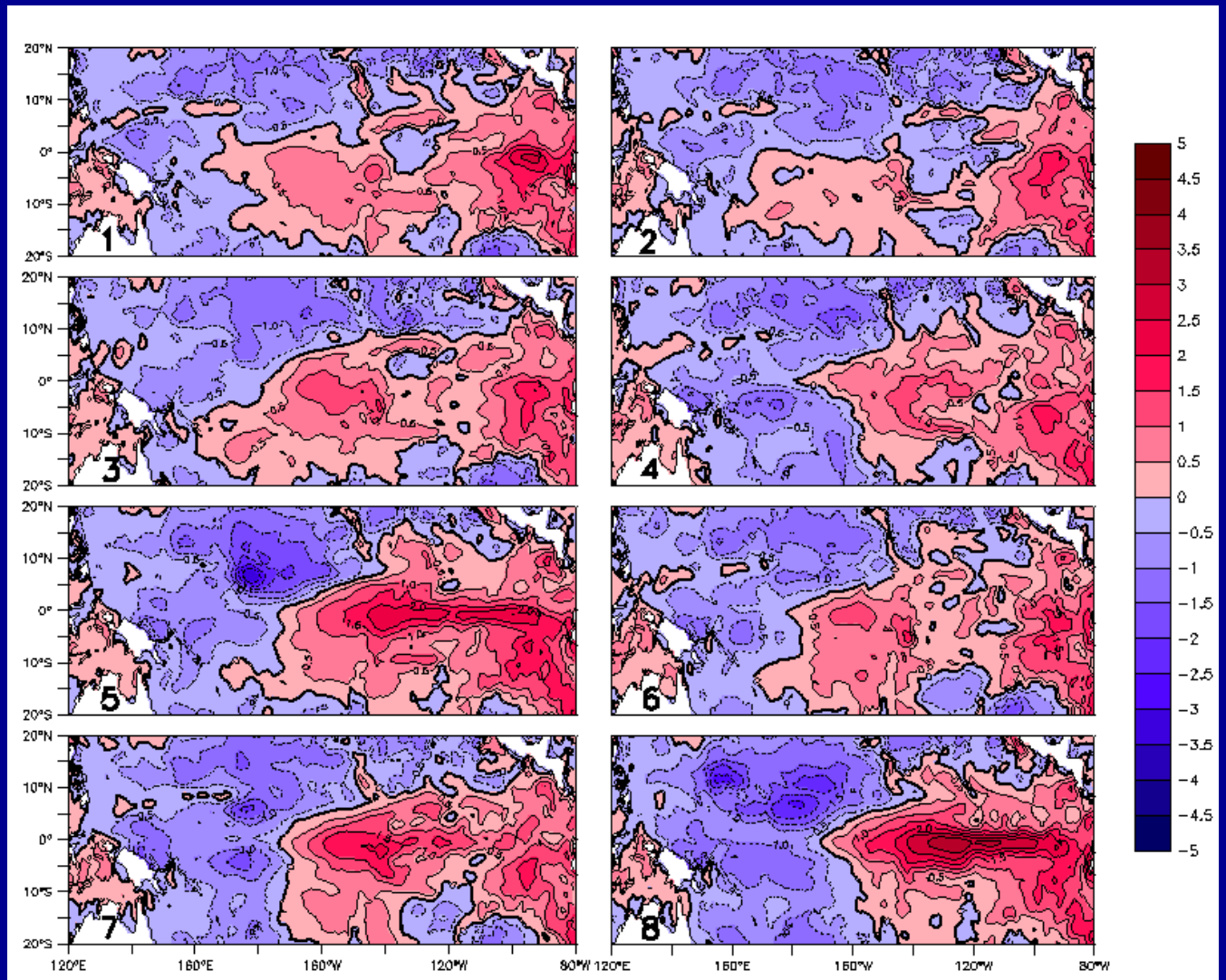

1918
1919
J F M A M J J A S O N D J F M A M J J A S O N D
140°E
180°
140°W
100°W
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
−0.4
−0.8
−1.2
−1.6
−2
−2.4
−2.8
−3.2
−3.6
−4
6
5.4
4.8
4.2
3.6
3
2.4
1.8
1.2
0.6
0
−0.6
−1.2
−1.8
−2.4
−3
−3.6
−4.2
−4.8
−5.4
−6
1918/1919 SODA XP 56 Ensemble Member Mean
TAUX Anomalies(N/m2)
SST Anomalies(° C)

Niño 3.4 SST

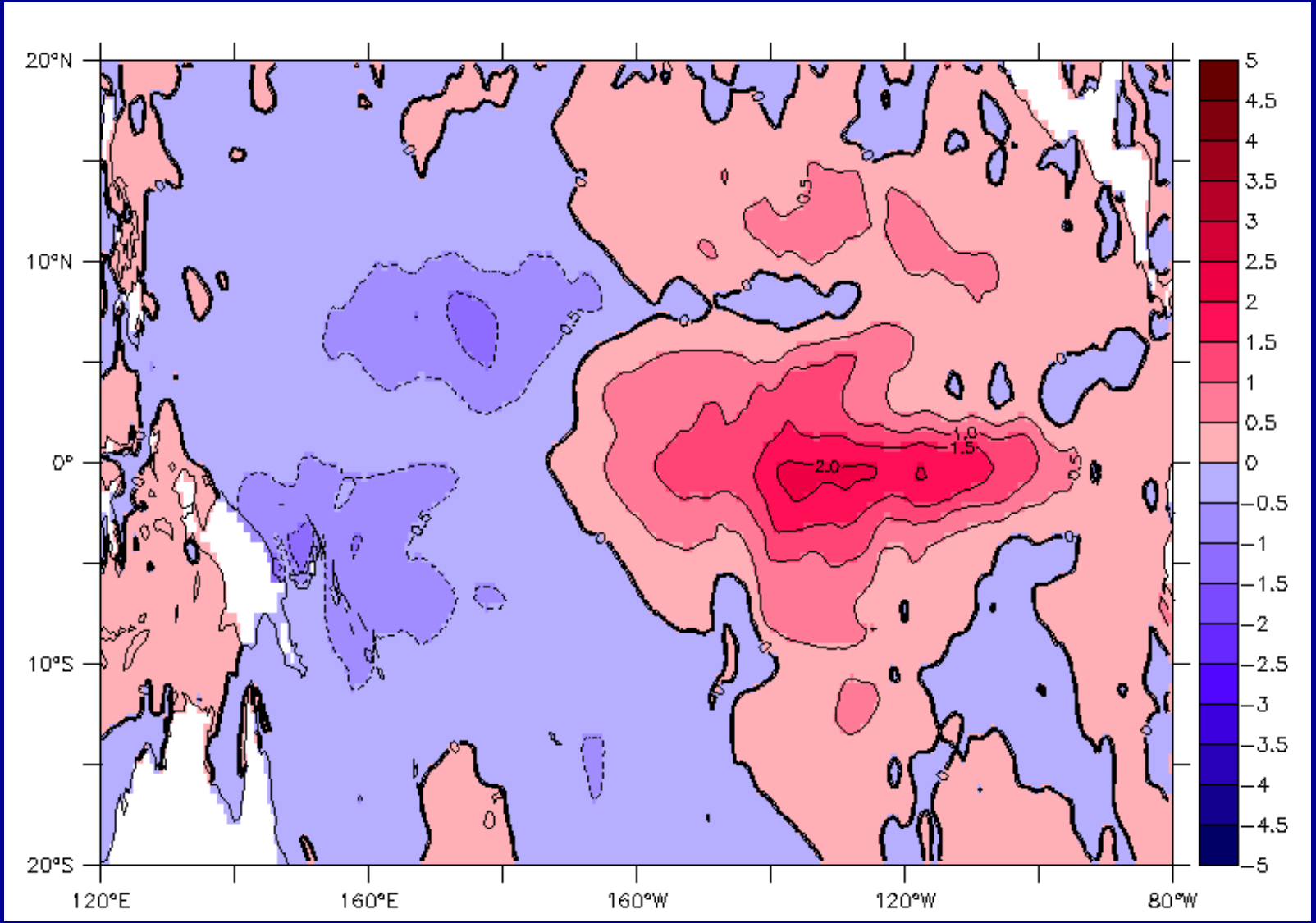
Blue - HadISST Black – SODAsi.1 Red – SODA XP



8 Group Averages 7 Ensemble members each

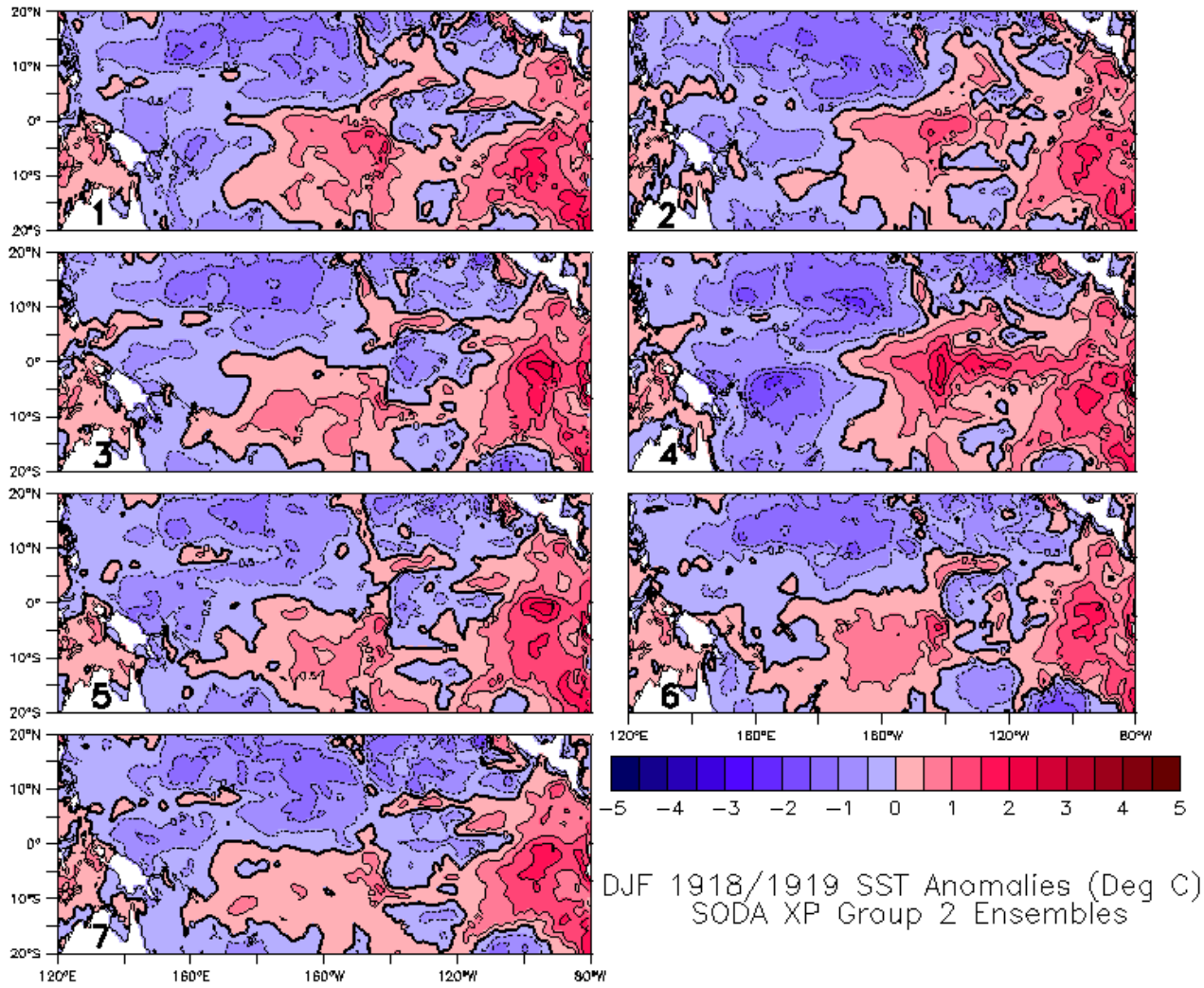


DJF ENS average 08 – ENS average 02



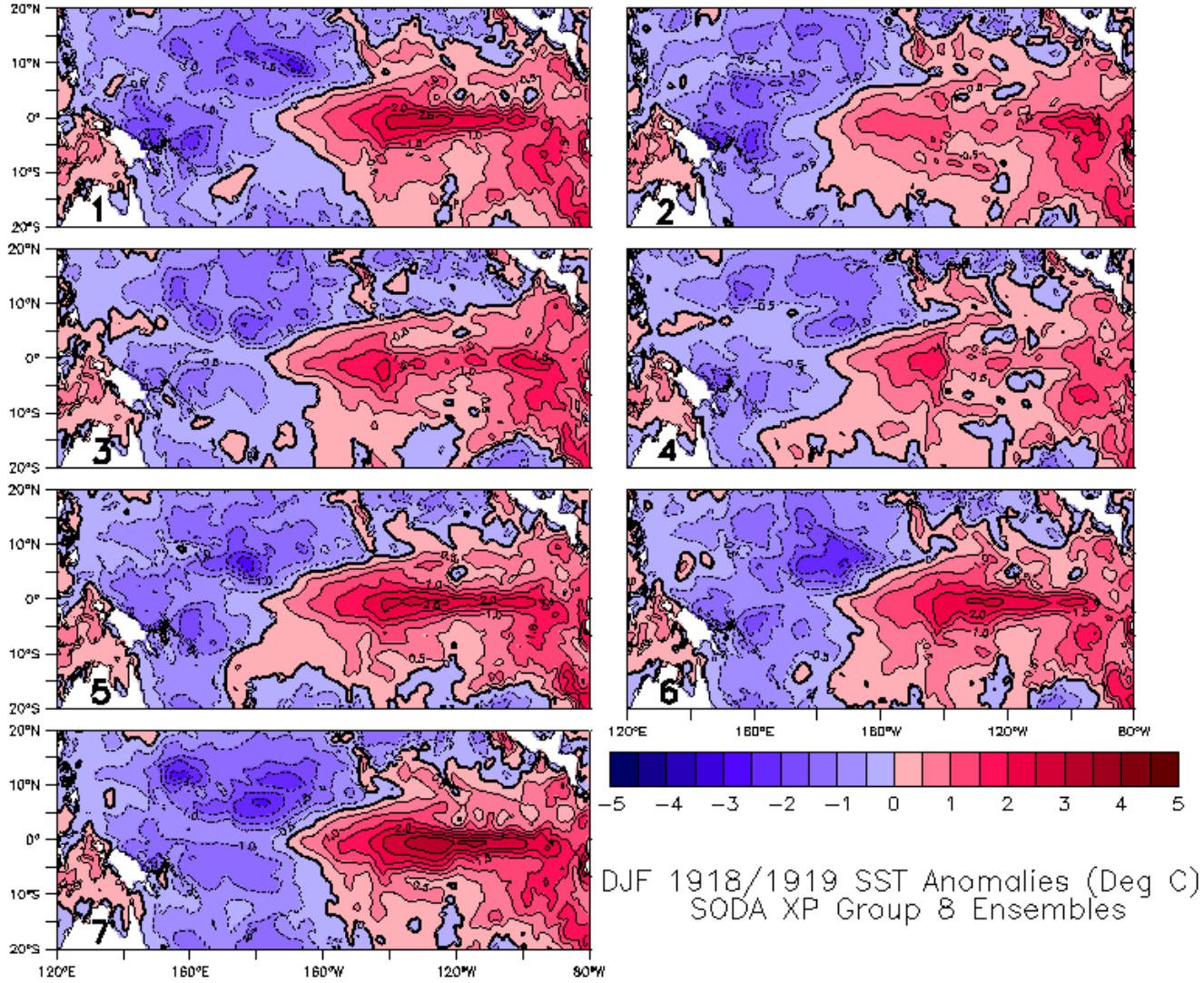
Group 2

Each Member

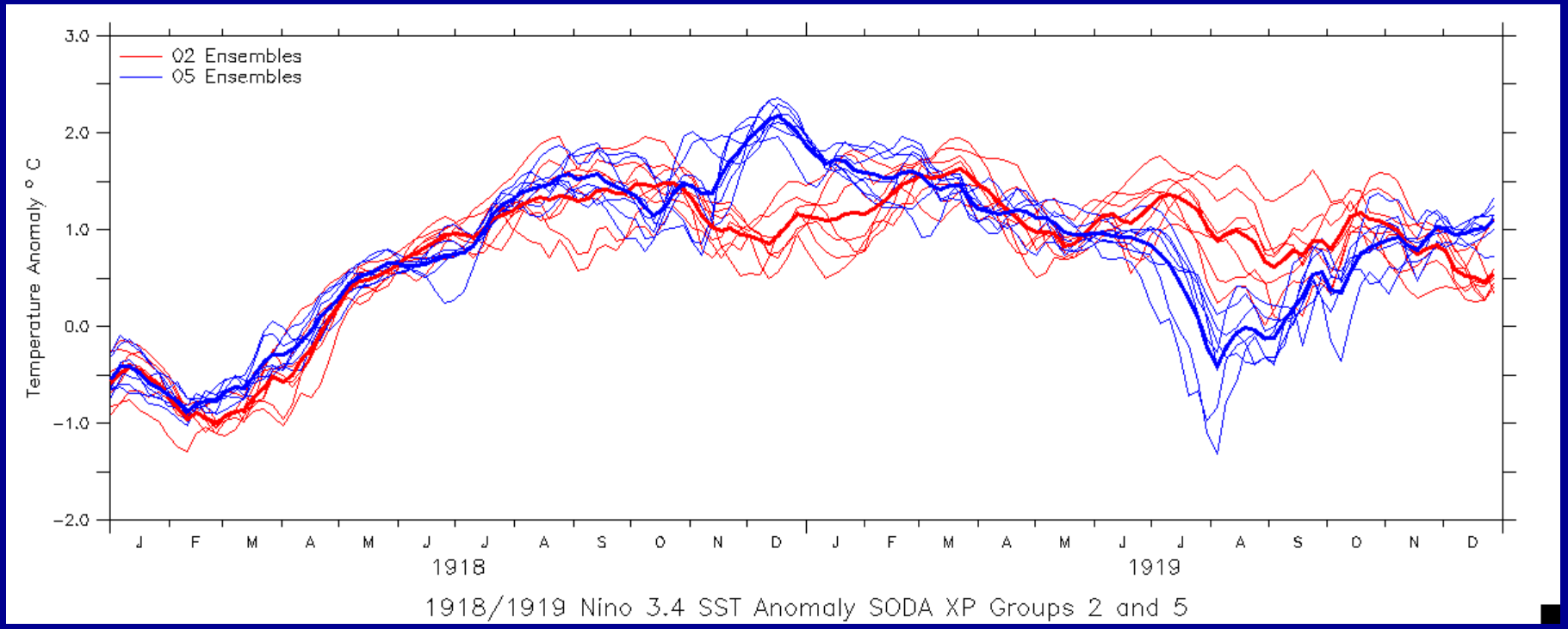


Group 8

Each Member



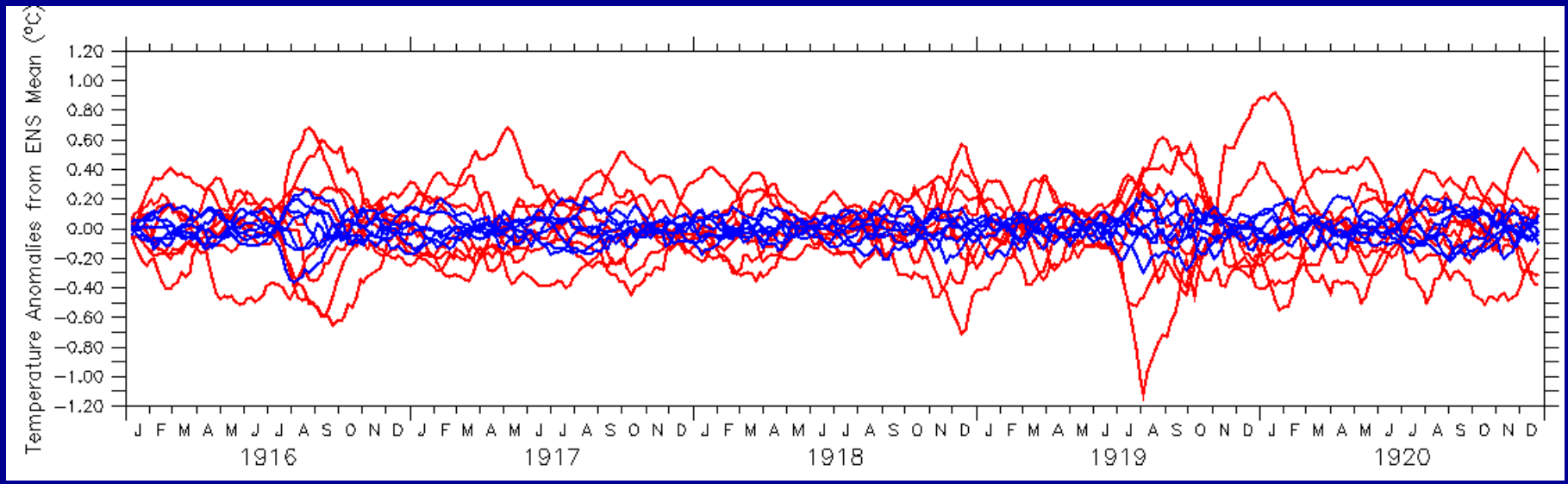
Niño 3.4 SST – Groups 2 and 5

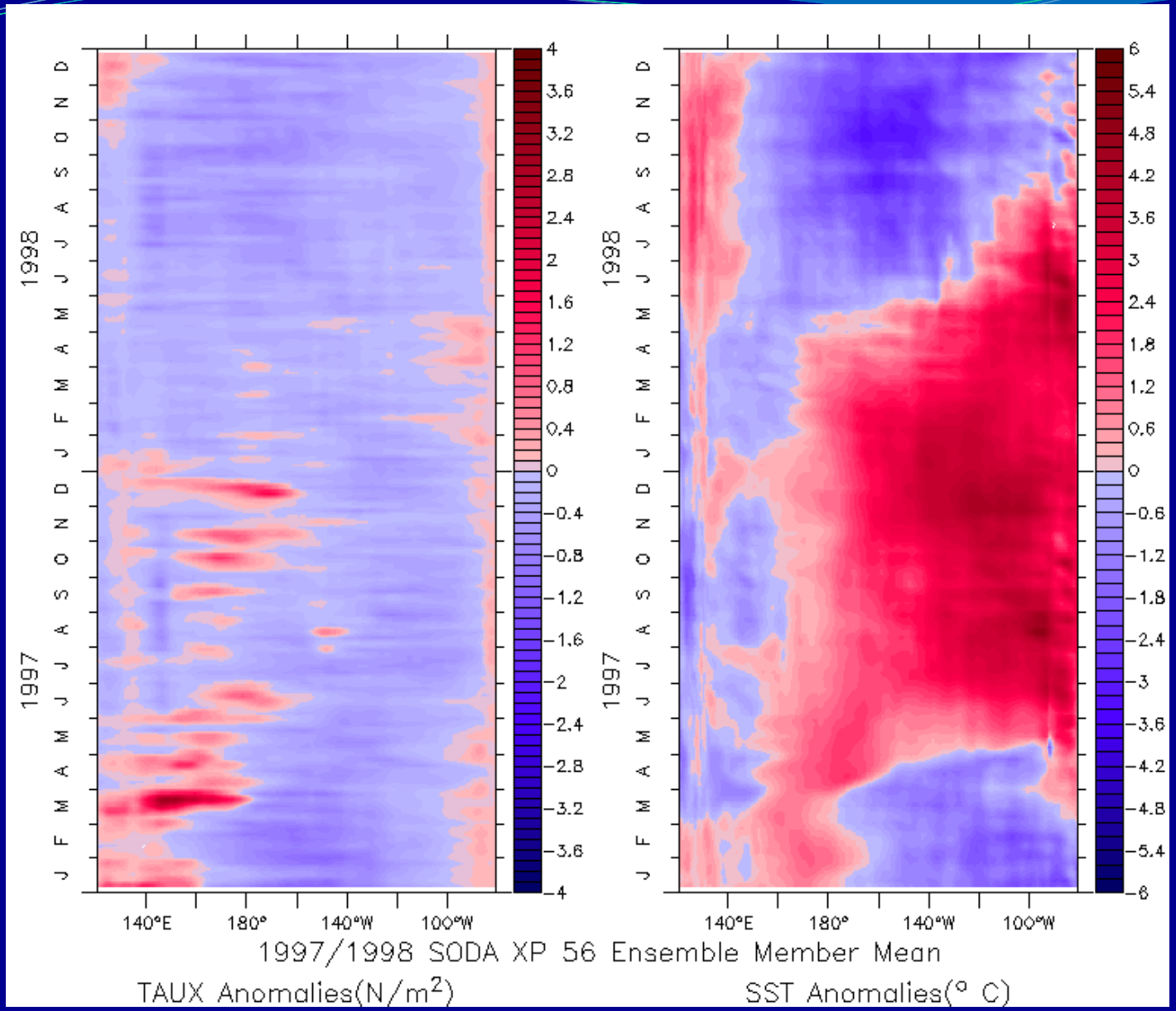


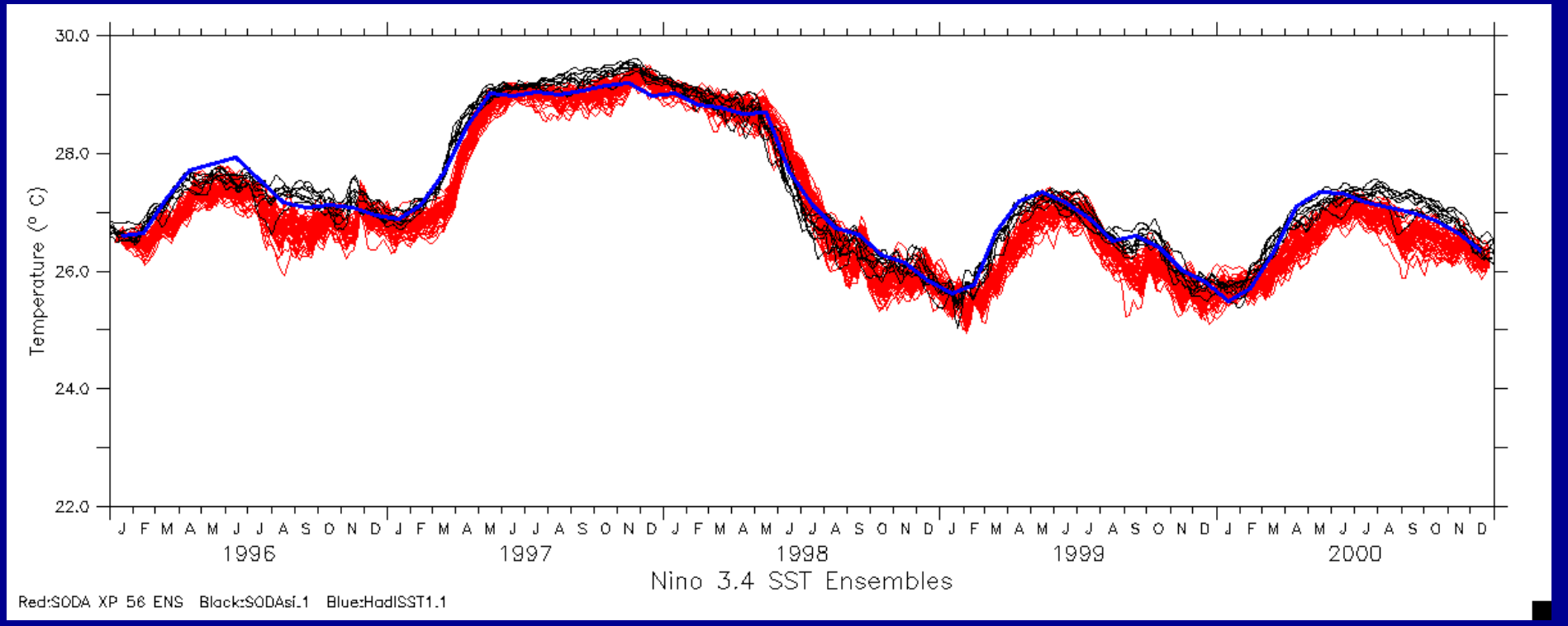
Niño 3.4 SST

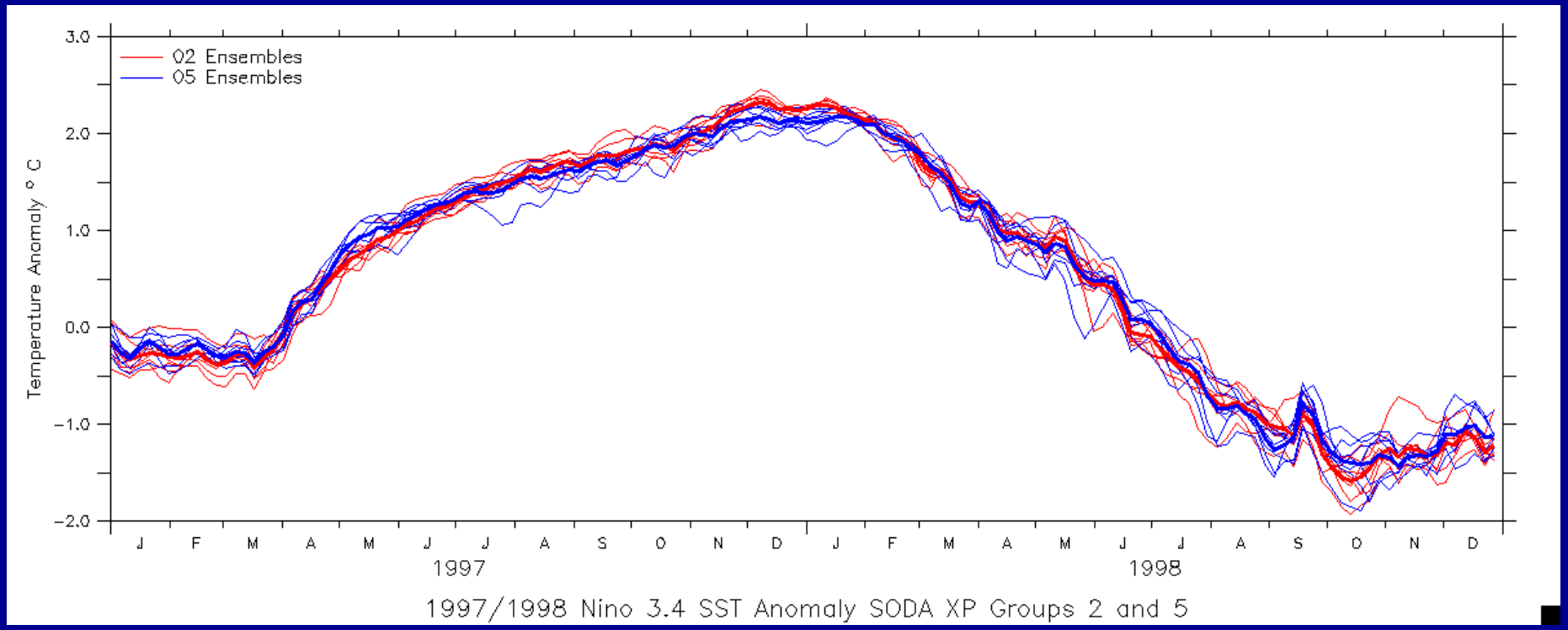
Red – Difference between Group mean and 56-member mean

Blue – Difference between 8 member mean – one from each group and 56-member mean




1998
1997
J F M A M J J A S O N D J F M A M J J A S O N D
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
−0.4
−0.8
−1.2
−1.6
−2
−2.4
−2.8
−3.2
−3.6
−4
140°E
180°
140°W
100°W
6
5.4
4.8
4.2
3.6
3
2.4
1.8
1.2
0.6
0
−0.6
−1.2
−1.8
−2.4
−3
−3.6
−4.2
−4.8
−5.4
−6
1997/1998 SODA XP 56 Ensemble Member Mean
TAUX Anomalies(N/m2)
SST Anomalies(° C)


30.0
28.0
26.0
24.0
22.0
Temperature (° C)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1996
1997
1998
1999
2000
Nino 3.4 SST Ensembles
Red:SODA XP 56 ENS Black:SODAsi.1 Blue:HadISST1.1


02 Ensembles
05 Ensembles
Temperature Anomaly ° C
3.0
2.0
1.0
0.0
-1.0
-2.0
J F M A M J J A S O N D J F M A M J J A S O N D
1997
1998
1997/1998 Nino 3.4 SST Anomaly SODA XP Groups 2 and 5

- Two sources of uncertainty in the ocean reanalyses
  1. Inherent atmospheric noise
     - Present with both sparse and dense observations
  2. Prescribing SST to the atmosphere
     - Increasing observations markedly reduces this uncertainty
- A coupled reanalysis system is required to represent the range of possible climate states for periods of few observations